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## MEMORANDUM

To: Mr. George Desmond

From: Anthony Urbano

Date: June 25, 2020

File No.: 05.0046650.02

Re: Geohydrologic Review

GZA GeoEnvironmental, Inc. (GZA) has completed a geohydrologic review at the 6 Manitou Court, Westport, Connecticut (Site). This memorandum was prepared to address one of the Connecticut Department of Energy and Environmental Protection (CTDEEP) comments in their May 29, 2020 letter (comment 2G). Specifically, we evaluated whether the upland groundwater seeps have the potential to cause slope failure that would impact the nearby seawall, and other proposed structures. Our services were conducted in accordance with our proposal dated June 18, 2020. This memorandum is subject to the Limitations provided in Appendix A.

### SITE BACKGROUND

Our understanding of the project is based on a plan set entitled 5.5.20 Preliminary Bid Set. The 1.3-acre Site is developed with an existing single-story residence, a 2-story Boathouse, walkways, retaining walls, seawall and paved and landscape areas. The single-story residence is in the central area of the site and has a footprint of approximately 1,000 square feet (sf). The Boathouse is in the western area of the site, has a footprint of approximately 1,700 sf.

The Site is located along the tidally influenced Saugatuck River and the western portion of the Site, including the existing Boathouse, is within the FEMA VE14 Zone. Refer to Figure 2 for existing conditions.

### PROPOSED DEVELOPMENT

We understand the project consists of demolishing the existing single-story residence, renovating the existing Boathouse, and constructing a Barn. Site improvements include concrete walkways, new retaining walls, and landscape areas.

The existing Boathouse will be raised to elevate the first floor to El. 21 feet. The new foundation for the Boathouse will be on bedrock. The Boathouse will be renovated and reduced to a footprint of about 1,600 sf. The basement level will remain at El. 6.9 feet and will be used as storage space.

The proposed Barn will have a footprint of about 2,350 sf. Proposed first floor and basement slab elevations for the Barn will be El. 32 feet and El. 21 feet, respectively. The basement level will have a 7-foot by 25-foot by 4.6-foot deep indoor hydro pool.





New retaining walls are proposed throughout the property and will be up to 11-feet high. Based on the planned finished floor grades, cuts of about 10 feet will be required to meet design grades for the proposed Barn. Cuts and fills are expected be a few feet in other areas.

Some of the stormwater runoff will be directed to a 165 sf Gravel Trench located in the northwest portion of the Site. We understand the system is designed to infiltrate the design storm (i.e., 1-inch rainfall event) into the groundwater table. Larger design storms overflow the top of the Gravel Trench. The top of the Gravel Trench will be at elevation 17 feet and the bottom of the stone in the trench will be at elevation 15 feet. There is a 2 to 1 slope on the downgradient side of the Gravel Trench and at the base of the slope is a 1 to 2-foot-high stone retaining wall. A flat slope then extends 7 to 12 feet westward to the seawall. Refer to Figures 1 and C-2 for proposed conditions.

### **SUBSURFACE CONDITIONS**

GZA observed seven test pit explorations performed at the Site on April 10, 2020 (see Figure 1 for test pit locations). The subsurface conditions encountered at TP-1 (near the sea wall) was generally silty sand from 0 to 5.5 feet, organic silt from 5.5 to 6 feet, gravely sand from 6 to 7 feet, and refusal on bedrock at 7 feet. The remaining test pits generally encountered silty, gravely sand with cobbles to the top of the bedrock surface. Bedrock was encountered at depths ranging from 3 to 5 feet below grade in these test pits. Refer to GZA's May 29, 2020 geotechnical report for more details on subsurface conditions.

Groundwater was observed in TP-1 at a depth of 7 feet below existing grade, corresponding to El. 2 feet. Groundwater was not encountered in the remaining test pits. It should be noted that groundwater levels will vary due to tidal influences from the Saugatuck River, seasonal and climatic fluctuations, and changes caused by construction and stabilization time.

### **SITE VISIT**

A GZA geohydrologic engineer (Anthony Urbano) visited the Site on June 23, 2020 to look for groundwater seeps and surficial bedrock features. Numerous bedrock outcrops and large boulders were observed throughout the Site. We did not observe any groundwater seeps during our site visit, but we believe we observed evidence of a minor groundwater seep at one location. Specifically, we observed orange staining in the surficial soils beneath the west corner of the "Shed" (see Figure 2 for location). The orange staining can be indicative of iron precipitate that typically occurs when groundwater is exposed at the surface. Therefore, we believe there was previously exposed groundwater at this one isolated location beneath the "Shed".

A channel of orange stained surficial soil was observed beginning northeast of the of the "Existing 1-story Residence" and extending southwest toward the "Fire Pit" (see Figure 2 for locations). A more detailed investigation of this area identified the outfall of an approximately 6-inch diameter drainpipe buried a few inches below grade immediately northeast of the abutting "Stone Pad". This pipe was found to originate within the storm drain catch basin located immediately north of the "Shed". Significant orange precipitate was also observed in this catch basin. It is GZA's opinion that the orange stained surficial soil channel is from the storm drainpipe outfall, and not related to groundwater seepage.

A shallow channel of soil erosion was observed going down the slope originating at the edge of the paved parking area (near test pit TP-5). This is a low point of the paved parking area and at the base of a long driveway. It is GZA's opinion that this soil erosion was caused by surficial runoff of the paved surface, and not groundwater seepage. There was no orange staining of the soil in this area.

GZA observed a few areas of exposed silty, gravely sand at the ground surface at the Site, but these areas appeared to match up with either GZA's or Landtech's previous test pit exploration locations.





The western seawall has some voids between the stone blocks, and the bottom of the seawall is undermined in a few areas. These conditions have reportedly allowed some soil settlement immediately adjacent to the landward side of the sea wall that requires periodic maintenance to fill the settled areas.

## RECOMENDATIONS

In order to prevent upland groundwater seeps that have the potential to cause slope failure that would impact the nearby seawall, and other proposed structures, we recommend the following:

1. Relocate the storm drain outfall northeast of the existing building to an alternative location that will not cause surficial erosion or groundwater seeps.
2. The area downgradient of the Gravel Trench (with 2 to 1 side slopes and a stone retaining wall at the base of the slope) should be designed to prevent surficial erosion or groundwater seeps. In addition, the southern portion of the Gravel Trench should be adjusted such that the top surface of the Gravel Trench (at elevation 17 feet) will be consistent with the proposed grades in that area, and will not cause seepage breakout at the abutting lawn steps (to the south).
3. The western seawall should have a woven filter fabric installed on the landward side of the wall to a depth of the mudline and then backfilled with sand and gravel to prevent undermining and loss of soils beneath and through the seawall. In addition, the seawall should incorporate the use of weep holes near the base of the wall.
4. The groundwater underdrains beneath the proposed Barn structure and the indoor hydro pool should either extend around the entire perimeter of these structures or should be tied into a 12-inch thick slab drainage structure. The discharge from the underdrain system should be directed to an area that will not cause surficial erosion or groundwater seeps.
5. All of the earth retaining walls should include either weep holes spaced 4 feet on center or include drainage at the base of the retaining walls.
6. The downgradient side of the paved surfaces should incorporate a large enough curb to prevent large storm events from overtopping the curbs. In addition, a stone filled groundwater interceptor trench should be located downgradient of the pervious pavement area and should be piped to an area that will not cause surficial erosion or groundwater seeps.
7. The proposed generator and transformers should be moved slightly to avoid the isolated groundwater seep location beneath the Shed (which is planned to be removed).





We appreciate the opportunity to work for you on this Project. Please contact the undersigned if you have any questions at 401-374-2317 or [anthony.urbano@gza.com](mailto:anthony.urbano@gza.com).

GZA GEOENVIRONMENTAL, INC.

A handwritten signature in blue ink that reads "Anthony Urbano".

Anthony B. Urbano, P.E.<sup>MA and RI</sup>  
Senior Project Manager

A handwritten signature in blue ink that reads "D. Barstow".

David M. Barstow, P.E.  
Associate Principal

A handwritten signature in blue ink that reads "James Davis".

James Davis, P.E.  
Consultant Reviewer

A handwritten signature in blue ink that reads "Lawrence F. Johnsen".

Lawrence F. Johnsen, P.E.  
Senior Consultant

Attachments: Appendix A – Limitations  
Figure 1 – Test Pit Location Plan  
Figure C-2



## Appendix A





## USE OF REPORT

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the contract documents, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

## STANDARD OF CARE

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report, as appropriate, to reflect the unanticipated changed conditions.
3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, express or implied, is made.
4. In conducting our work, GZA relied upon certain information made available by public agencies, Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Inconsistencies in this information which we have noted, if any, are discussed in the Report.

## SUBSURFACE CONDITIONS

5. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs. The nature and extent of variations between these explorations may not become evident until further exploration or construction. If variations or other latent conditions then become evident, it will be necessary to reevaluate the conclusions and recommendations of this report.
6. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.
7. Water level readings have been made in test holes (as described in this Report) and monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water table encountered in the course of the work may differ from that indicated in the Report.
8. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.





9. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

#### **COMPLIANCE WITH CODES AND REGULATIONS**

10. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

#### **COST ESTIMATES**

11. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

#### **ADDITIONAL SERVICES**

12. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.



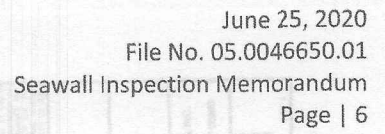
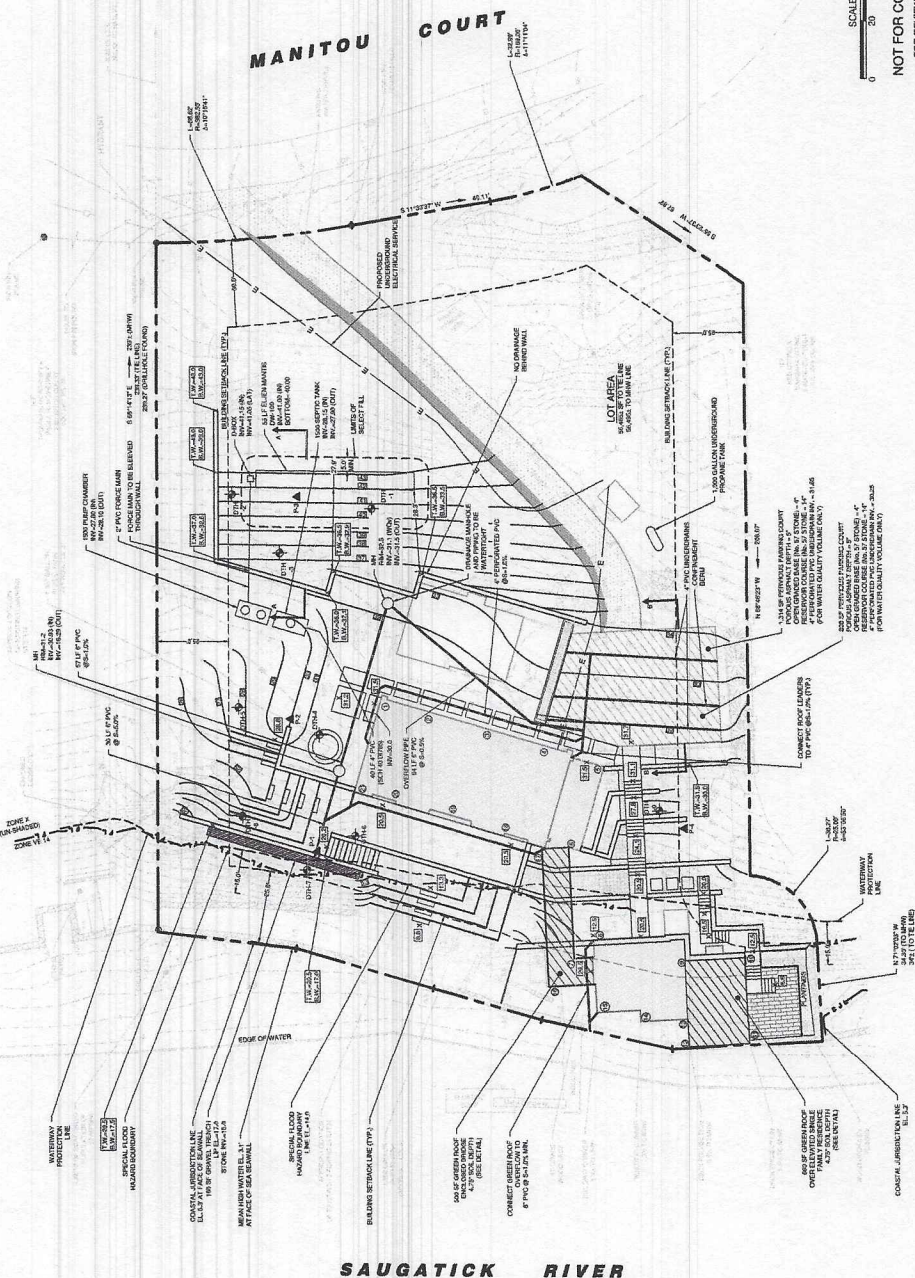




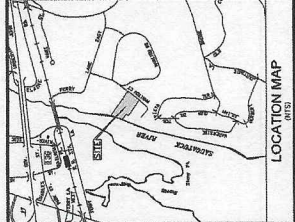


Figure C-2





## SAUGATICK RIVER



GENERAL NOTES

### GENERAL NOTES

[illegible]

PROPOSED AVERAGE BUILDING GRADE		
Spot Elev. No.	Grade	Elevation
1	3	31.2
2	3	31.5
3	3	31.5
4	4	31.5
5	5	31.1
6	6	24.1
7	7	14.1
8	8	15.1
9	9	16.6
10	10	12.5
11	11	6.6
12	12	7.3
13	13	7.3
14	14	7.8
15	15	7.8
16	16	7.3
17	17	24.1
18	18	16.6
19	19	16.6
20	20	16.6
21	21	18.6
Total		238.7
No. of Points		21.0
AVERAGE		16.8

[illegible]